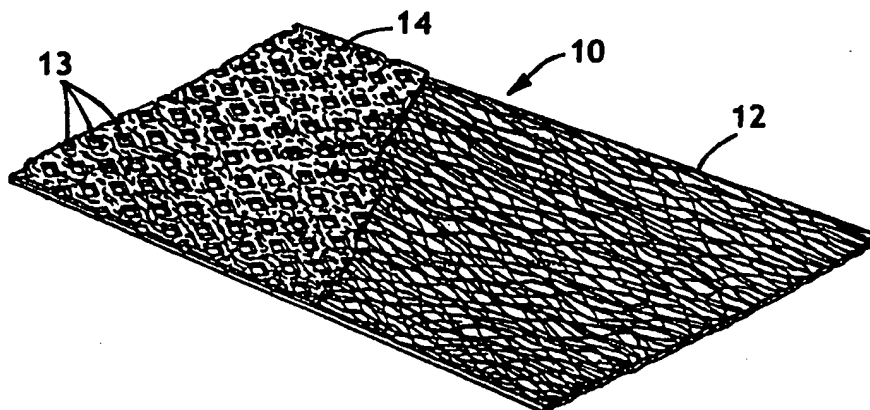




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : D04H		A2	(11) International Publication Number: WO 00/37723
			(43) International Publication Date: 29 June 2000 (29.06.00)
(21) International Application Number: PCT/US99/30403 (22) International Filing Date: 20 December 1999 (20.12.99) (30) Priority Data: 60/112,847 19 December 1998 (19.12.98) US 09/465,298 17 December 1999 (17.12.99) US (71) Applicant: KIMBERLY-CLARK WORLDWIDE, INC. [US/US]; 401 N. Lake Street, Neenah, WI 54956 (US). (72) Inventors: CLARK, Darryl, Franklin; 10365 Plantation Bridge Drive, Alpharetta, GA 30022 (US). DUELLMAN, Justin, Max; Apartment 1524, 11900 Pleasant Ridge Road, Little Rock, AR 72223 (US). HAYNES, Bryan, David; 7125 Fox Chase Way, Cumming, GA 30040 (US). LAKE, Matthew, Boyd; 6640 Fox Creek Drive, Cumming, GA 30040 (US). MCMANUS, Jeffrey, Lawrence; 206 Morning Glory Ridge, Canton, GA 30115 (US). SMITH, Kevin, Edward; 283 Fielding Lane, Roswell, GA 30076 (US). (74) Agents: TULLEY, Douglas, H., Jr. et al.; Kimberly-Clark Worldwide, Inc., 401 N. Lake St., Neenah, WI 54956 (US).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>Without international search report and to be republished upon receipt of that report.</i>	

(54) Title: FINE MULTICOMPONENT FIBER WEBS AND LAMINATES THEREOF



(57) Abstract

The present invention provides multicomponent fine fiber webs and multilayer laminates thereof having an average fiber diameter less than about 7 micrometers and comprising a first olefin polymer component and a second distinct polymer component such as an amorphous polyolefin or polyamide. Multilayer laminates incorporating the fine multicomponent fiber webs are also provided such as, for example, spunbond/meltblown/spunbond laminates or spunbond/meltblown/meltblown/spunbond laminates. The fine multicomponent fiber webs and laminates thereof provide laminates having excellent softness, peel strength and/or controlled permeability.

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FINE MULTICOMPONENT FIBER WEBS AND LAMINATES THEREOF

FIELD OF THE INVENTION

5 The present invention relates to meltblown fiber webs and, in particular, to multicomponent meltblown fiber webs and laminates thereof.

BACKGROUND OF THE INVENTION

10 Multicomponent spunbond fibers refer to fibers which have been formed from at least two polymer streams but spun together to form a unitary fiber. The individual components comprising the multicomponent fiber are usually different polymers and are arranged in distinct zones or regions that extend continuously along the length of the fibers. The configuration of such fibers can vary and commonly the individual components of the
15 fiber are positioned in a side-by-side arrangement, sheath/core arrangement, pie or wedge arrangement, islands-in-sea arrangement or other configuration. Multicomponent fibers and methods of making the same are known in the art and, by way of example, are generally described in U.S. Patent 5,344,297 to Hills; U.S. Patent 5,336,552 to Strack et al. and U.S. Patent 5,382,400 to Pike et al.

20 Generally, methods for making spunbond fiber nonwoven webs include extruding molten thermoplastic polymer through a spinneret, quenching the filaments and then drawing the quenched filaments with a stream of high velocity air to form a web of randomly arrayed fibers on a collecting surface. As examples, methods for making the same are described in U.S. Pat. No. 4,692,618 to Dorschner et al., U.S. Pat. No.
25 4,340,563 to Appel et al. and U.S. Patent 3,802,817 to Matsuki et al. However, meltblown fabrics comprise a class of melt formed nonwoven fabrics which is distinct from those of spunbond fiber webs. Meltblown fiber webs are generally formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity, air streams which attenuate the filaments
30 of molten thermoplastic material to reduce their diameter. Thereafter, the meltblown fibers are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Meltblown fiber processes are disclosed in, for example, U.S. Patent 3,849,241 to Butin et al.; U.S. Patent No. 5,160,746 to Dodge et al.; U.S. Patent No. 4,526,733 to Lau; and others. Meltblown fibers may be continuous or discontinuous and are generally smaller than
35 about 10 microns in average diameter. In addition, meltblown fibers are generally tacky when deposited onto a collecting surface or other fabric.

has a hydrohead of at least 50 mbars, a Frazier air permeability in excess of 70 cubic feet/minute/square foot and cup crush energy of less than about 2150 g-mm. Desirably, the first layer comprises a meltblown fiber web and the second and third layers comprise spunbond fiber layers. In still a further aspect, the multilayer laminate may further comprise a fourth layer, such as a monocomponent meltblown fiber web, which is adjacent the first layer and also positioned between the second and third layers.

BRIEF DESCRIPTION OF THE DRAWINGS

10 FIG. 1 is a partially broken-away view of a multilayer nonwoven laminate incorporating a multicomponent meltblown fiber web.

FIG. 2 is a partially broken-away view of a multilayer nonwoven laminate incorporating a multicomponent meltblown fiber web.

15 FIG. 3 is a cross-sectional view of a meltblowing die suitable for making multicomponent meltblown fabrics.

FIG. 4A is a schematic drawing illustrating the cross section of a multicomponent, fiber suitable for use with the present invention, with the polymer components A and B in a side-by-side arrangement.

20 FIG. 4B is a schematic drawing illustrating the cross section of a multicomponent fiber, suitable for use with the present invention, with the polymer components A and B in an eccentric sheath/core arrangement.

FIG. 5 is a schematic representation of an elevated perspective view of a die suitable for practicing present invention.

25 FIG. 6 is a schematic representation of a cross-sectional view of the meltblowing nozzle, looking in the direction of arrows numbered 102--102 in Fig. 5.

FIG. 7 is a schematic representation of a process line suitable for forming multicomponent meltblown web laminates of the present invention.

FIG. 8 is a cross-sectional view of a multicomponent meltblown fiber laminate of the present invention.

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DESCRIPTION OF THE INVENTION

Nonwoven webs of the present invention comprise randomly interlaid webs of fine multicomponent fibers. The term "multicomponent" refers to fibers that have been formed from at least two polymer streams and extruded to form a unitary fiber. A specific species of multicomponent fibers is bicomponent fibers, which simply comprise fibers having two

corresponding laminate. As but one example, infection control products or medical fabrics desirably comprise a multicomponent meltblown fiber layer having a basis weight between about 12 g/m² and about 25 g/m². Additionally, the multicomponent meltblown fibers have a fiber diameter less than about 10 μ and desirably have a diameter between about 0.5 μ and about 7 μ and still more desirably have a fiber diameter between about 2 μ and about 5 μ .

The multicomponent meltblown fiber webs of the present invention can have excellent drape and softness and, as an example, multicomponent meltblown webs having a basis weight of about 34 g/m² or less can have a cup crush energy value of less than about 150 g-mm and more desirably less than about 100 g-mm. Further, the fabric softness can be achieved without the need for additional mechanical and/or chemical softening treatments. Additionally, the multicomponent meltblown fiber web can additionally have excellent bulk, air-permeability and/or tensile strength. In one aspect, the multicomponent meltblown fabrics of the present invention can comprise durable fabrics having machine direction Peak Strain (%) values of 40% or more and even in excess of about 50%. Additionally, the multicomponent meltblown fibers can provide high surface area fabric with good filtration efficiency while still also providing good air-permeability. For example, 20 g/m² multicomponent meltblown fiber webs (of 38cm² fabric) can have air-permeability values of about 50 cubic feet per minute (CFM) or more and even air-permeability values of about 100 CFM or more. In addition, the multicomponent meltblown fabrics can have supported hydrohead values in excess of about 50 mbars.

The polymeric components of the multicomponent meltblown fibers can be selected from thermoplastic polymers suitable for use in making meltblown fiber webs such as, for example, polyolefins, polybutylenes, polyamides, polyesters, polyurethanes, acrylates (e.g. ethylene-vinyl acetates, ethylene methyl acrylates, etc.), EPDM rubbers, acrylic acids, polyamide polyether block copolymers, block copolymers having the general formula A-B, A-B-A or A-B-B-A such as copoly(styrene/ethylene-butylene), styrene-poly(ethylene-propylene)-styrene, styrene-poly(ethylene-butylene)-styrene, as well as other polymers suitable for use in meltblown processes. In addition, blends and/or copolymers of the aforesaid polymers are likewise suitable use in one or more components of the meltblown fiber. Further, highly amorphous polymers and/or tacky resins which are commonly used as adhesives can also be used as one or more components of the multicomponent fiber. Examples include, but are not limited to, amorphous polyalphaolefins such as for example, ethylene/propylene copolymers such as the REXTAC family of amorphous polyalphaolefins from Huntsman Corp. and VESTOPLAST polymers from Creanova AKG.

5,272,236, both to Lai et al.; U.S. Patent No. 5,554,775 to Krishnamurti et al.; and U.S. Patent No. 5,539,124 to Etherton et al.; the entire contents of the aforesaid references are incorporated herein by reference. Commercially available polymers made with such catalysts are available from Dow Chemical Company under the trade name ENGAGE, from
5 DuPont-Dow under the trade name ENGAGE and from Exxon Chemical Company under the trade name ACHIEVE. As a specific example, the multicomponent fibers can comprise a first component of a propylene polymer having a polydispersity number of about 3 or more and a second polymer component comprising a propylene polymer having a polydispersity number less than about 2.5.

10 In a further aspect, the fine multicomponent fibers can comprise a first olefin polymer component and a second olefin polymer component wherein the second polymer has a lower density than the first olefin polymer. Still further, the first component can comprise a substantially crystalline polypropylene and the second component can comprise an amorphous polypropylene, that is to say a polypropylene polymer having a lower degree of
15 crystallinity. Desirably the first component has a crystallinity, as measured by the heat of fusion (ΔH_f), at least about 25 J/g greater than that of the second component and, still more desirably, has a crystallinity of at least about 40 J/g greater than that of the second component. As a particular example, the first component can comprise conventional polypropylene and the second component can comprise an amorphous polypropylene. In
20 one aspect, the relative degree of crystallinity and/or polymer density can be controlled by the degree branching and/or the relative percent of isotactic, syndiotactic and atactic regions within the polymer. As indicated above, conventional polyolefins generally comprise substantially crystalline polymers and generally have a crystallinity in excess of 70 J/g and more desirably, however, have a crystallinity of about 90 J/g or more. In one aspect, the
25 amorphous propylene polymers desirably have a crystallinity of about 65 J/g or less. The degree of crystallinity, or heat of fusion (ΔH_f), can be measured by DSC in accord with ASTM D-3417.

Exemplary propylene based amorphous polymers believed suitable for use with the present invention are described in U.S. Patent No. 5,948,720 to Sun et al.; U.S. Patent No.
30 5,723,546 to Sustic et al.; European Patent No. 0475307B1 and European patent No. 0475306B1; the entire content of the aforesaid references are incorporated herein by reference. As further specific examples, the amorphous ethylene and/or propylene based polymers desirably have densities between about 0.87 g/cm³ and 0.89 g/cm³. However, various amorphous polypropylene homopolymers, amorphous propylene/ethylene
35 copolymers, amorphous propylene/butylene copolymers, as well as other amorphous propylene copolymers believed suitable for use in the present invention are known in the art.

The multicomponent fibers can also comprise a first component comprising propylene, such as conventional polypropylene, and a second component comprising a propylene/ethylene copolymer such as, for example, a random copolymer of propylene and ethylene comprising a minor portion of ethylene. An exemplary propylene-ethylene random copolymer is commercially available from Union Carbide Corp. under the designation 6D43 which comprises about 3% ethylene. Additional propylene-ethylene copolymers believed suitable for use with the present invention include olefin multi-step reactor products wherein an amorphous ethylene propylene random copolymer is molecularly dispersed in a predominately semi-crystalline high propylene monomer/low ethylene monomer continuous matrix. Examples of such polymers are described in European Patent No. 400,333B1 and U.S. Patent No. 5,482,772 to Strack et al.; the entire contents of which are incorporated herein by reference. Such polymers are commercially available from Himont, Inc., under the trade name CATALLOY polymers.

In a further aspect, a first component can comprise a low melt-flow rate (MFR) polyolefin and a second component can comprise a high melt-flow rate olefin polymer. As a particular example, a bicomponent fiber can comprise a polyethylene such as, for example, linear low-density polyethylene, and the second component can comprise a polypropylene having a MFR in excess of 800 g/10 min. at 230°C. As a further example, the first component can comprise a low melt-flow rate polypropylene, having a MFR less than 800 g/10 min. at 230°C, and the second component can comprise a high melt-flow rate polypropylene, having a MFR in excess of 800 g/10 min. at 230°C. High melt-flow rate polymers and methods of making the same are known in the art. As an example, high melt-flow rate polymers are described in commonly assigned U.S. Patent No. 5,213,881 to Timmons et al., the entire contents of the aforesaid reference is incorporated herein by reference. Melt-flow rate (MFR) can be determined before the polymer is melt-processed in accord with ASTM D1238-90b; the specific test conditions (i.e. temperature) will vary with the particular polymer as described in the aforesaid test. Test conditions for polypropylene are 230/2.16 and 190/2.16 for polyethylene.

Further, the multicomponent fibers can comprise a first component comprising a first polyolefin and a second component comprising a polyolefin blend. The polyolefin blend can comprise, in part, the same or different polyolefin as that in the first component. Further, the first polyolefin can optionally comprise a distinct polymer blend. As an example, the first component can comprise a conventional polypropylene and the second component can comprise a blend of a conventional polypropylene and an amorphous polypropylene. As a further example, the first component can comprise polypropylene and the second component can comprise a blend of an identical or similar polypropylene and

provide a channel 58, adjacent die 50, which direct the attenuating air past die tip 55. The molten polymer is extruded from die tip 55 and drawn by the primary air, which moves through channels 58 in the direction of the arrows associated therewith. Methods and apparatus for making multicomponent nonwoven webs are also described in U.S. Patent No. 3,425,091 to Ueda et al.; U.S. Patent No. 3,981,650 to Page; and U.S. Patent No. 5,601,851 to Terakawa et al.

In conventional meltblowing apparatus and processes the primary air is maintained at a temperature above the melting point of the polymer. Thus, when using conventional meltblowing apparatus the primary or attenuating air will typically have a temperature above the melting point of each of the polymers comprising the individual polymeric components. However, as discussed in more detail herein below, the primary or attenuating air can, optionally, have a temperature above or below the melting point of one or more of the extruded polymers. The multicomponent meltblown fibers and resulting webs can be made in accord with meltblowing processes such as, for example, those described in U.S. Patent 3,849,241 to Butin et al.; U.S. Patent No. 5,160,746 to Dodge et al.; U.S. Patent No. 4,526,733 to Lau; U.S. Patent No. 5,652,048 to Haynes et al.; U.S. Patent No. 5,366,793 to Fitts et al. and Naval Research Laboratory Report No. 4364 entitled "Manufacture of Superfine Organic Fibers" by V. Wente, E. Boone and C. Fluharty; the entire contents of the aforesaid references are incorporated herein by reference. In addition, melt spray equipment can likewise be used and/or adapted to create such multicomponent fibers and, by way of example only, exemplary melt spray apparatus and processes are generally described in U.S. Patent No. 4,949,668 to Heindel et al.; U.S. Patent No. 4,983,109 to Miller et al. and U.S. Patent No. 5,728,219 to Allen et al.

Conventional meltblown systems can be used to make multicomponent meltblown fiber webs of the present invention and such systems typically use hot air to keep the fiber molten and to draw the fiber. However, as indicated above, a variety of combinations of polymeric components can be utilized in connection with the present invention and, in this regard, due to the disparity in melting points, quench rates and other characteristics of these polymers it will often be advantageous to primarily attenuate the extruded multicomponent fibers to the desired fiber diameter with "cold" air. As used herein the term cold air refers to air below the melting point of at least one of the polymeric components. In a further aspect, multicomponent meltblown fibers can be primarily attenuated to the desired diameter with air at a temperature below the melting point of the lowest melting polymeric component. Once the meltblown fibers have been attenuated to reach desired diameters, the process must allow for quenching, or cooling, of the fiber to solidify it. Multicomponent meltblown fibers can be made using a coflowing hot air/cold air

As shown in FIG. 5, die tip 110 defines a polymer supply passage 130 that terminates in further passages 132 defined by die tip 110 which are commonly referred to as capillaries. Capillaries 132 are individual passages that communicate directly with opening 111 and that generally run substantially the length of die tip 110. A divider (not shown) can separate polymer streams A and B until substantially through the length of passage 130 and adjacent capillary 132. In reference to FIG. 6, which is an enlarged cross-sectional view of die tip 110, capillaries 132 generally have a diameter that is smaller than the diameter of polymer supply passage 130. Typically, the diameters of all the capillaries 132 will be the same so as to have uniform fiber size formation. The diameter of the capillaries 132 is indicated on Fig. 2 by the double arrows designated "d, d." A typical capillary diameter "d" is 0.0145 inches. The length of the capillary 132 is indicated on Fig. 2 by the designating letter "L". Capillaries 132 desirably have a 10/1 length/diameter ratio.

As shown in FIG. 6 for example, capillary 132 is configured to expel liquid polymer through exit opening 108 as a liquid polymer stream, which is designated by the letter "P." The liquid polymer stream P exits through exit opening 108 in die tip 110 and flows in a direction generally parallel to that of the capillaries 132. In reference to FIGS. 5 and 6, the fiber-forming portion of the die apparatus 100 includes first and second inner walls 116 disposed generally opposite each other to form a mirror image. Inner walls 116 are also known as "hot air plates" or "hot plates." As shown in Figs. 5 and 6, hot air plates 116 are configured and disposed to cooperate with die tip 110 in order to define first and a second secondary hot air flow channel 120. The secondary hot air channels 120 are located with respect to die tip 110 so that hot air flowing through the channels will shroud die tip 110.

The secondary hot air channels 120 are the channels along which a hot air stream moves during use so that die tip 110 can remain at a sufficiently high temperature to ensure that the polymer stream P will not prematurely quench, or solidify, so that it may be drawn by the cold primary air. In addition, the hot air shroud formed by cooperating secondary hot air channels 120 prevents polymer at or near the die tip 110 from freezing and breaking off. First and second outer walls 118 are also referred to as "cold air plates" or "cold plates", are configured and disposed to cooperate with the outer surface of hot air plates 116 to define first and second primary cold air channels 122 therebetween. The distance "R" that the cold air plates 118 extend below the plane created by hot air plates 116 can vary and, in another aspect, the cold air plates can be positioned parallel with (R=0) or slightly above the plane created by hot air plates 116. The first and second primary cold air channels 122 are configured to direct a substantial quantity of fluid flowing through the channels in a direction substantially parallel to the axis of the capillary 132. In

As used herein the term "nonwoven" fabric or web means a material having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a knitted or woven fabric. Nonwoven fabrics or webs have been formed by many processes such as, for example, meltblowing processes, spunbonding processes, hydroentangling, air-laid and bonded carded web processes. Additional laminate structures and suitable materials for forming the same are discussed herein below in greater detail.

The sheet material can be made in-line or unwound from a winder roll and directed under a multicomponent meltblown die thereby forming the multicomponent fibers directly upon the sheet material. Meltblown fibers are often tacky when deposited and thus, depending upon the intended use or application of the laminate, further bonding between the two layers may be unnecessary. However, it will often be desirable to increase the peel strength of the laminate by additional bonding processes. In this regard, the cohesion between the layers can be increased as desired by one or more means known in the art such as, for example, by thermal, ultrasonic and/or adhesively bonding the layers together. As an example, sheet 14 and multicomponent meltblown fiber web 16 can be pattern bonded such as, for example, by point bonding. As used herein "point bonding" means bonding one or more layers of fabric at numerous small, discrete bond points. As a specific example, thermal point bonding generally involves passing one or more layers to be bonded between heated rolls such as, for example, an engraved or patterned roll and a second roll. The engraved roll is patterned in some way so that the fabric is not bonded over its entire surface, and the second roll can either be flat or patterned. As a result, various patterns for engraved rolls have been developed for functional as well as aesthetic reasons. Desirably the multilayer laminates are pattern bonded such that the bonded area comprises less than 50% of the fabric surface area and still more desirably the bonded area comprises between about 5% and about 30% of the fabric surface area. Exemplary bond patterns and/or bonding processes suitable for use with the present invention include, but are not limited to, those described in U.S. Design Patent No. 356,688 to Uitenbroek et al; U.S. Patent No. 4,374,888 to Bornslaeger; U.S. Patent No. 3,855,046 to Hansen et al.; U.S. Patent No. 5,635,134 to Bourne et al.; and U.S. Patent No. 5,858,515 to Stokes et al.; and PCT Application US94/03412 (publication no. WO95/09261). In reference to FIG. 2, a multilayer laminate 15 is provided having excellent peel strength with the outer layers 16, 20 and intermediate multicomponent meltblown layer 18 are bonded together at a plurality of discrete bond points 13. Various methods of forming cohesive multi-layer laminates are further described herein below in greater detail.

Multicomponent meltblown web laminates, such as an SMS laminate, desirably have excellent drape and correspondingly low cup crush values. SMS laminates of the

Patent No. 5,382,400 to Pike et al.; U.S. Patent No. 5,622,772 to Stokes et al.; U.S. Patent No. 5,695,849 to Shawver et al.; U.S. patent Application No. 08/671,391 to Griesbach et al.; the entire contents of the aforesaid references are incorporated herein by reference.

In one aspect, the spunbond fibers can comprise, at least in part, a similar and/or identical
5 polymer to that comprising one of the components of the multicomponent meltblown fabric. Still further, the spunbond fiber can comprise a polymer having the same or similar melting point as the polymer comprising the lower melting component of the multicomponent meltblown fiber web.

The spunbond fibers 65 can be deposited upon foraminous surface 62 that travels
10 in the direction of the arrows associated therewith. The spunbond fiber layer 66 travels, upon forming surface 62, underneath a first bank of multicomponent meltblown fiber machines 70 which deposits multicomponent meltblown fibers directly upon the spunbond fibers. Vacuum box 63 can be positioned underneath the forming surface 62, proximate meltblown machine 72, to aid in formation of the meltblown fiber web. Polymers A and B
15 can be fed via separate conduits from reservoirs 67 and 68 to meltblown machine 70. One or more layers of meltblown fiber webs can be formed thereover as desired. In reference to FIG. 7, three consecutive meltblown machines 70, 74 and 78 are shown each depositing respective layers of meltblown fibers 72, 76 and 80. However, each meltblown layer need not be multicomponent meltblown nor does each layer need to comprise the
20 same combination of polymeric components. As an example, one or more of the meltblown fiber layers can comprise distinct polymer combinations. Desirably, however, each of the meltblown and spunbond fiber webs have at least one substantially similar or identical polymer.

Subsequent to the deposition of meltblown fiber layers 72, 76 and 80, spunbond
25 fibers 83 can be deposited over the forming surface and, in particular, over the upper most meltblown fiber web 80, to form spunbond fiber layer 84. One or more additional layers of spunbond or other fibers can be deposited thereover as desired. Additionally, the second spunbond layer 84 can comprise identical, similar and/or a distinct material relative to the underlying spunbond fiber layer 66. As an example, one spunbond layer
30 can be selected to provide excellent hand whereas the other can be selected to provide improved tensile strength, abrasion resistance, or other desired characteristics.

The multiple layers can then be treated to increase the peel strength of the resulting laminate. The layers can be bonded together by one or more means known in the art such as, for example, adhesively, thermally, and/or ultrasonically bonding. In reference to
35 FIG. 7, the multiple layers can be fed through nip 87 formed by first and second rollers

electret articles from polyolefin nonwoven webs are known in the art and, as examples thereof, the webs and laminates of the present invention can be electret treated in a manner as described in U.S. patent No. 4,215,682 to Kubic et al., U.S. Patent No. 4,375,718 to Wadsworth et al. and U.S. Patent No. 5,401,446 to Tsai et al.

5 In a further aspect, the multicomponent meltblown fiber webs and/or laminates thereof can be formed into permanent three-dimensional shapes. As used herein, "three-dimensional shape" means a fabric having dimension in the X (length) , Y (width) and Z (thickness) directions wherein each dimension of the shaped fabric is greater than the thickness of the fabric itself. As an example, a flat or sheet-like fabric that has been
10 treated to have a permanent cup-like shape is a three-dimensionally shaped fabric when the permanent curvature of the fabric is such that the shaped article has a Z direction greater than the fabric thickness. The three-dimensional shape of the pad may be imparted by one of several methods and as examples the multicomponent meltblown webs or laminates thereof can be molded or thermoformed into the desired shape.
15 Desirably the multicomponent meltblown fiber web or laminate thereof is thermoformed in a manner so as to retain the good hand and softness such as described in U.S. Patent No. 5,695,376 to Pike et al.; the entire content of the aforesaid references are incorporated herein by reference. The three-dimensionally shaped web or laminate is desirably reversibly-deformable, that is to say that the article has a permanent three-
20 dimensional shape that can be bent or deformed and that will readily return to its original three-dimensional shape upon removing the deforming force. As examples, the multicomponent meltblown fiber webs and/or laminates thereof can comprise the shape of an article such as a feminine pad, a nursing pad, a facemask, and so forth.

The laminates of the present invention can be utilized for or as a component in
25 garments such as, for example, in industrial workwear, undergarments, pants, shirts, jackets, gloves, socks, etc. Further, laminates of the present invention can be employed in infection control products such as surgical gowns and drapes, face masks, head coverings, foot and shoe coverings, wound dressings, bandages, sterilization wraps, wipers, patient bedding and so forth. Still further, laminates of the present invention can be utilized in one
30 or more various aspects as a component within personal care products, e.g. personal hygiene oriented items such as diapers, training pants, absorbent underpants, adult incontinence products, feminine hygiene products, and the like. As specific non-limiting examples thereof, the multicomponent meltblown fiber webs and/or laminates thereof can be used in conjunction with or in a manner as described in the following references: U.S.
35 Patent No. 4,720,415 to Vander Wielen et al.; U.S. Patent No. 3,949,128 to Ostermeier; U.S. Patent No. 5,620,779 to Levy et al.; U.S. Patent No. 5,714,107 to Levy et al., U.S.

NC The specimen is subjected to a standardized water pressure, increased at a constant rate until the first sign of leakage appears on the surface of the fabric in three separate areas. (Leakage at the edge, adjacent to clamps is ignored.) Unsupported materials, such as a thin film or nonwoven, are supported to prevent premature rupture of the specimen.

5 Drape: The drape test measures a fabric's stiffness or resistance to bending. The drape stiffness test determines the bending length of a fabric using the principle of cantilever bending of the fabric under its own weight. The bending length is a measure of the interaction between fabric weight and fabric stiffness. A 1 inch (2.54 cm) by 8 inch (20.3 cm) fabric strip is slid, at 4.75 inches per minute (12 cm/min) in a direction parallel to its long
10 dimension so that its leading edge projects from the edge of a horizontal surface. The length of the overhang is measured when the tip of the specimen is depressed under its own weight to the point where the line joining the tip of the fabric to the edge of the platform makes a 41.5 degree angle with the horizontal. The longer the overhang the slower the specimen was to bend, indicating a stiffer fabric. The drape stiffness is calculated as 0.5 x
15 bending length. A total of 5 samples of each fabric should be taken. This procedure conforms to ASTM standard test D-1388 except as noted herein above. The test equipment used is a Cantilever Bending tester model 79-10 available from Testing Machines Inc., 400 Bayview Ave., Amityville, NY 11701.

 Tensile Strength: Tensile strength or peak load measures the maximum load (gram
20 force) before the specimen ruptures. A 4 inch by 6 inch sample is placed in a 1 inch by 1 inch rubber coated clamp or jaws and a 1 inch by 2 inch rubber coated clamp or jaws (with the longer dimension being perpendicular to the load) so that the machine direction (i.e. the direction in which the fabric is made) is parallel with the load. The sample is placed in the jaws such that there is a 3 inch gage length. The test can be performed with
25 an 1130 Instron Tensile Tester (available from Instron Corporation of Canton, MA) and utilizes a cross-head speed of 12 inches/minute and a 10 pound load cell. The load at rupture is reported in grams. The normalized tensile strength is calculated by dividing the tensile strength by the basis weight (in grams per square meter) and is reported in g per g/m². Peak strain is the percent elongation at peak load.

30 Cup Crush: The softness of a nonwoven fabric may be measured according to the "cup crush" test. The cup crush test evaluates fabric stiffness by measuring the peak load or "cup crush" required for a 4.5 cm diameter hemispherically shaped foot to crush a 25 cm by 25 cm piece of fabric shaped into an approximately 6.5 cm diameter by 6.5 cm tall inverted cup while the cup shaped fabric is surrounded by an approximately 6.5 cm diameter
35 cylinder to maintain a uniform deformation of the cup shaped fabric. An average of 10 readings is used. The foot and the cup are aligned to avoid contact between the cup walls

capillary entrance. The first polymer comprised linear low-density polyethylene (DOW 6831A LLDPE) and the second polymer comprised an amorphous polypropylene homopolymer (Huntsman 121 FPO). The meltblown was formed using hot primary air having a temperature of about 226°C. The resulting bicomponent meltblown had a side-by-side cross-sectional configuration and the first and second components each comprised about 50%, by volume, of the fiber. The 0.5 ounce/square yard (17 g/m²) meltblown fabric had a supported hydrohead of 51 mbar and an air permeability of 92 cubic feet/minute/square foot.

Example 3: First and second polymers were melted and the respective molten polymer streams were separately directed through the die apparatus until just prior to the die capillary entrance. The first polymer comprised an amorphous propylene polymer (Huntsman 120 FPO) and the second polymer comprised crystalline polypropylene (Exxon 3505 polypropylene). The resulting bicomponent meltblown had a side-by-side cross-sectional configuration and the first and second components each comprised about 50%, by volume, of the fiber. The 0.6 ounce/square yard (20 g/m²) meltblown fabric had a peak load of 1.74 pounds (0.79 kg) and a peak stain of about 56% in the machine direction and a peak load of 1.04 pounds (0.47 kg) and a peak strain of about 83% in the cross-direction.

Example 4: First and second polymers were melted and the respective molten polymer streams were separately directed through the die apparatus until just prior to the die capillary entrance. The first polymer comprised linear low density polyethylene (DOW 6831A LLDPE) and the second polymer comprised conventional polypropylene (Motnell PF015 polypropylene). The resulting 17 g/m² bicomponent meltblown fabric had a side-by-side cross-sectional configuration and the first and second components each comprised about 50%, by volume, of the fiber. The meltblown fabric was juxtaposed between two nonwoven webs of bicomponent spunbond fibers. The bicomponent spunbond fibers comprised 50/50 polyethylene/polypropylene sheath/core fibers and had a basis weight of 17 g/m² each. The three layers were thermally point bonded using a pattern which bonds approximately 18 % of the surface area of the fabric. The SMS laminate had a supported hydrohead of 66 mbar, an air permeability of 70 cubic feet/minute/square foot, a cup crush energy of 2032 g-mm and an average drape of 1.74 cm in the cross-direction and 3.22 in the machine direction.

7. The nonwoven web laminate of claim 6 wherein at least one component in each of said first, second and third layers comprises a propylene polymer and further wherein said multilayer laminate has a cup crush energy less than 2050 g-mm.
8. The nonwoven web laminate of claim 6 wherein at least one component in each of said first, second and third layers comprises an ethylene polymer and further wherein said multilayer laminate has a cup crush energy less than 2050 g-mm.
9. The nonwoven web laminate of claim 5 wherein said laminate has a Frazier air permeability in excess of 100 cubic feet/minute/square foot.
10. The nonwoven web laminate of claim 5 wherein the first polymeric component of said multicomponent meltblown fiber web comprises a propylene polymer having a crystallinity above 70 J/g and further wherein the second polymeric component of said meltblown fiber web comprises an amorphous polyalphaolefin having a crystallinity below about 65 J/g.
11. The nonwoven web laminate of claim 5 wherein said second and third spunbond layers are extensible and further wherein the first polymeric component of said multicomponent meltblown fiber web comprises an elastic polyolefin and wherein said second component of the multicomponent meltblown fiber web comprises an elastic polymer.
12. The nonwoven web laminate of claim 11 wherein the second component of the multicomponent meltblown fiber web comprises an elastic polyolefin.
13. The nonwoven web laminate of claim 11 wherein the second component of the multicomponent meltblown fiber web comprises a blend of a polyolefin and a non-olefin thermoplastic elastomer.
14. The nonwoven web laminate of claim 11 wherein the second component of the multicomponent meltblown fiber web comprises an elastic non-olefin thermoplastic elastomer.
15. The nonwoven web laminate of claim 11 wherein the second component of the multicomponent meltblown fiber web comprises a block copolymer having a styrenic moiety end block and an elastomeric mid-block.

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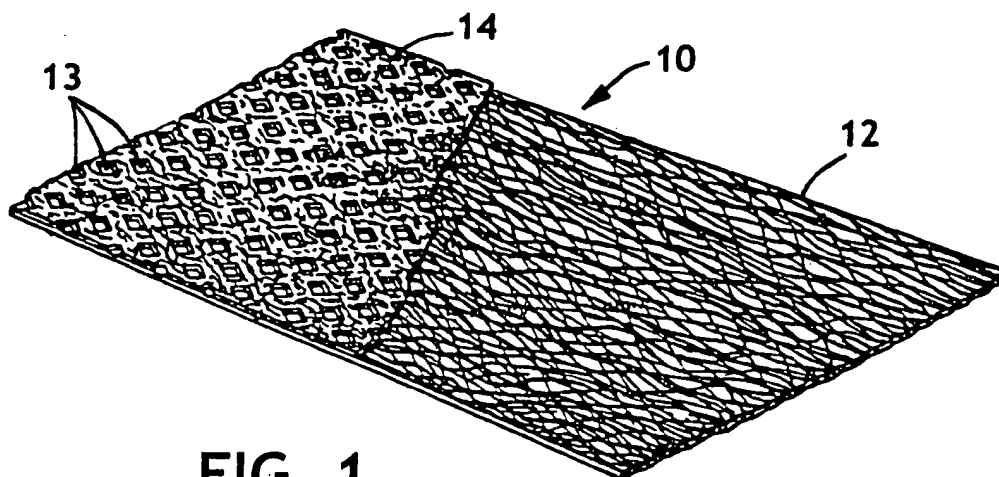


FIG. 1

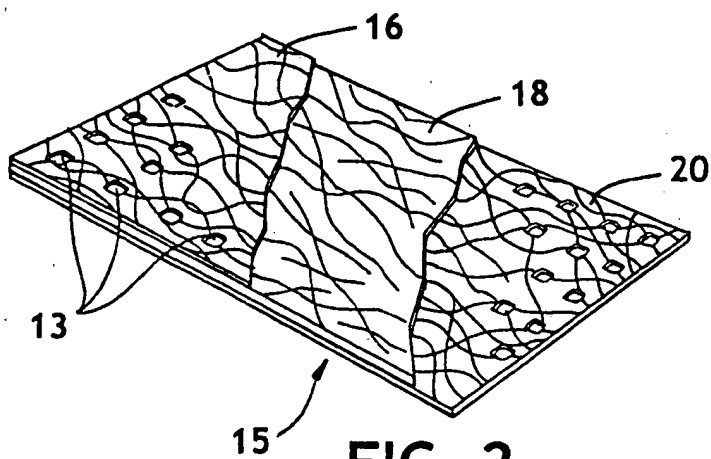


FIG. 2

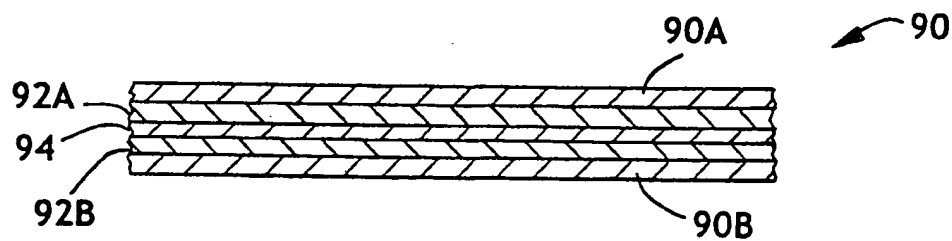


FIG. 8

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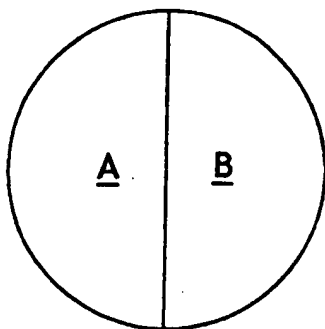


FIG. 4A

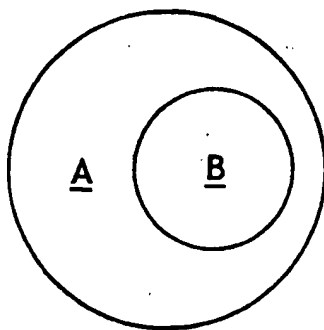
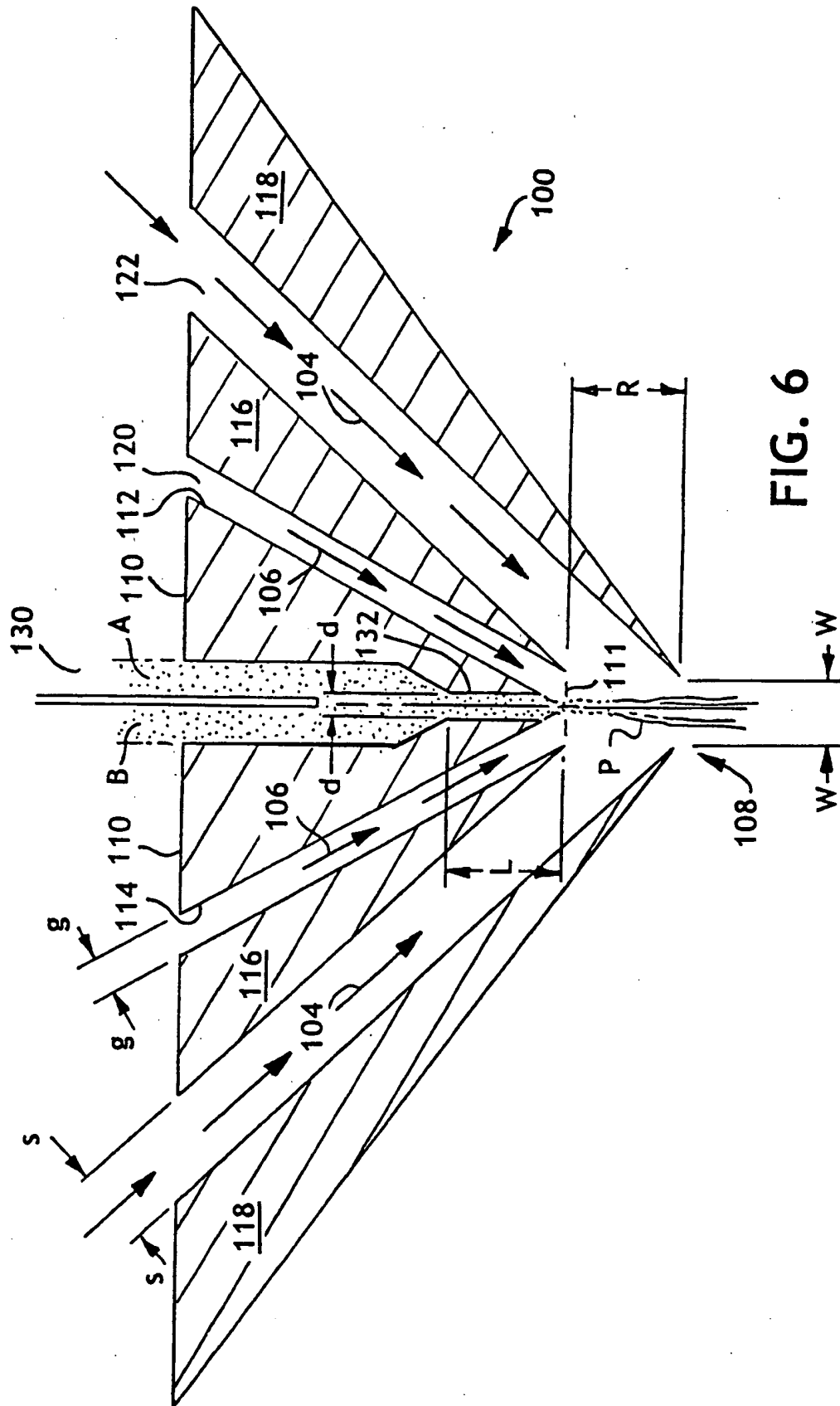


FIG. 4B

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